Demonstration of Computer-Based Forecasting for Childhood Immunization and Related Knowledge Maintenance Tools

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Introduction. The demonstration will present several related computer programs designed to help manage childhood immunization. IMM/Serve performs immunization forecasting, accepting a child's immunization history and producing patient-specific recommendations. A related suite of prototype tools are designed to assist in the key problem of maintaining IMM/Serve's knowledge over time: 1) as the clinical field evolves and 2) as different organizations build customized versions to meet their specific needs.

Background. National panels currently produce guidelines which specify how childhood immunizations should be administered. The guidelines are complex and are modified quite frequently. At the same time numerous organizations are currently building (or have already built) immunization registries which collect and store children's immunization histories. These registries all have a potential need for a computer program which can be linked to their databases to perform immunization forecasting. To make the overall approach successful, however, a number of additional challenges must be confronted, including 1) the need to modify the knowledge base as the clinical field evolves, 2) the need for individual registries to customize the knowledge, and 3) the need to verify these new and/or customized versions of the knowledge to assure that the program operates correctly. Computer-based knowledge maintenance tools can help meet these challenges.

IMM/Serve. IMM/Serve currently produces childhood immunization recommendations for seven vaccine series: 1) Diphtheria Tetanus Pertussis, 2) *Haemophilus influenzae* type b, 3) Hepatitis A, 4) Hepatitis B, 5) Measles Mumps Rubella, 6) Polio, and 7) Varicella. IMM/Serve accepts as input a child's immunization history (which may be extracted from an immunization registry) and produces recommendations indicating which vaccinations are due as of a specified date, and which should be scheduled next. IMM/Serve's immunization knowledge is expressed in both tabular and rule-based form. (http://ycmi.med.yale.edu/immserve/)

Knowledge Maintenance Tools. Three prototype tools will be demonstrated which are designed to help in the knowledge maintenance process.

IMM/Def is a Lisp-based tool built to help double-check the heart ("kernel") of the rule-based knowledge contained in IMM/Serve. IMM/Def processes a relatively terse representation of the underlying logic ("definition logic") for each dose of each vaccine series. It then automatically produces the if-then rules which implement that logic in three different temporal contexts: 1) when a dose is due now, 2) when a dose is not yet due, and 3) when a dose should be scheduled to follow a dose that is due now. In the process of adapting the definition logic to operate correctly in each of these contexts, IMM/Def must make certain modifications to the logic.

IMM/Test is a Lisp-based tool which takes as input IMM/Def's definition logic for a vaccine series, together with a table of forecasting parameters for each dose, and automatically generates a set of test cases designed to help in the verification of the logic.

IMM/Graph is a domain-specific approach which allows the graphical visualization of immunization logic. The goal is to facilitate the understanding, discussion, and refinement of that logic by a knowledge engineering team, and to help identify any areas of ambiguity and incompleteness. IMM/Graph's visualization is currently created by hand.

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